

# Exhibit U

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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ALCATEL-LUCENT USA INC., CIENA CORPORATION, CORIANT (USA)  
INC., CORIANT NORTH AMERICA, LLC, CORIANT OPERATIONS, INC.,  
INFINERA CORPORATION, FUJITSU NETWORK COMMUNICATIONS,  
INC., HUAWEI TECHNOLOGIES CO. LTD., AND HUAWEI  
TECHNOLOGIES USA INC.,  
Petitioners,

v.

OYSTER OPTICS, LLC,  
Patent Owner.

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Case IPR2018-00070  
Patent 8,913,898 B2

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**DECLARATION OF KEITH W. GOOSSEN, Ph.D., IN SUPPORT OF  
PATENT OWNER'S RESPONSE**

IPR2018-00070 Declaration of Keith W. Goossen, Ph.D.

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I, Keith W. Goossen, hereby declare as follows:

**I. INTRODUCTION**

1. I have been retained as an expert on behalf of Oyster Optics, LLC (“Oyster”) for the above-captioned *Inter Partes* Review (“IPR”) involving U.S. Patent No. 8,913,898 (the “’898 patent”).

2. I am being compensated for my time in connection with this IPR at my standard consulting rate of \$350 per hour for consulting service and \$100 per hour for any necessary travel time. My compensation is not dependent on the outcome of this proceeding, the results of my analysis, or on the substance of my opinions and testimony.

3. I have been asked to provide my opinion on issues relevant to the validity of the ’898 patent. In particular, I have been asked to consider specific issues relevant to whether the Petition (“Pet.”) filed by the Petitioners listed on the cover of this declaration has established: (i) whether claims 1, 3-8, 10-12, 14-15, and 17-23 of the ’898 patent are unpatentable over Corke<sup>1</sup> in view of Swanson,<sup>2</sup>

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<sup>1</sup> Ex. 1206, U.S. Patent No. 5,510,917 to Corke (“Corke”)

<sup>2</sup> Ex. 1207, U.S. Patent No. 6,433,904 to Swanson *et al.* (“Swanson”).

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and further in view of Chikama,<sup>3</sup> (ii) whether claims 13 and 25 are obvious over Corke, Swanson and Chikama, and further in view of Mock,<sup>4</sup> (iii) whether claims 1, 5-9, 11-12, 14-15, and 19-24 are obvious over Choy,<sup>5</sup> in view of DeSalvo,<sup>6</sup> and further in view of Takahashi,<sup>7</sup> (iv) whether claims 2 and 16 are obvious over Choy, DeSalvo and Takahashi, and further in view of Reiner,<sup>8</sup> and (v) whether claims 3, 4, 10, 17, and 18 are obvious over Choy, DeSalvo and Takahashi, and further in view of Fatehi.<sup>9</sup> I have limited my analysis to the specific issues set forth in this Declaration.

4. In preparing this Declaration, I have reviewed the following materials:

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<sup>3</sup> Ex. 1208, Chikama *et al.*, “Modulation and demodulation techniques in optical heterodyne PSK transmission systems,” in *Journal of Lightwave Technology*, vol. 8, no. 3, pp. 309-322, Mar 1990 (“Chikama”).

<sup>4</sup> Ex. 1209, U.S. Patent No. 5,790,285 to Mock (“Mock”).

<sup>5</sup> Ex. 1210, U.S. Patent No. 5,825,949 to Choy *et al.* (“Choy”).

<sup>6</sup> Ex. 1211, U.S. Patent No. 6,980,747 to DeSalvo *et al.* (“DeSalvo”).

<sup>7</sup> Ex. 1212, U.S. Patent No. 5,680,246 to Takahashi *et al.* (“Takahashi”).

<sup>8</sup> Ex. 1213, U.S. Patent No. 4,419,595 to Reiner (“Reiner”).

<sup>9</sup> Ex 1214, U.S. Patent No. 4,878,726 to Fatehi (“Fatehi”).

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| <b>Description</b>   | <b>Paper or Exhibit No.</b> |
|--|-----------------------------|
| Petition for <i>Inter Partes</i> Review of U.S. Patent No. 8,913,898 (dated October 23, 2017)  | Paper 8                     |
| Decision: Institution of <i>Inter Partes</i> Review 37 C.F.R. § 42.108 (dated May 10, 2018)  | Paper 14                    |
| U.S. Patent No. 8,913,898 (the “898 Patent”)   | 1201                        |
| Declaration of Dr. Duncan MacFarlane   | 1202                        |
| U.S. Patent No. 5,510,917 (“Corke”)  | 1206                        |
| U.S. Patent No. 6,433,904 to Swanson <i>et al.</i> (“Swanson”)   | 1207                        |
| Chikama <i>et al.</i> , “Modulation and demodulation techniques in optical heterodyne PSK transmission systems,” in <i>Journal of Lightwave Technology</i> , vol. 8, no. 3, pp. 309-322, Mar 1990 (“Chikama”). | 1208                        |
| U.S. Patent No. 5,790,285 to Mock (“Mock”)   | 1209                        |
| U.S. Patent No. 5,825,949 to Choy <i>et al.</i> (“Choy”)   | 1210                        |
| U.S. Patent No. 6,980,747 to DeSalvo <i>et al.</i> (“DeSalvo”)   | 1211                        |
| U.S. Patent No. 5,680,246 to Takahashi <i>et al.</i> (“Takahashi”)   | 1212                        |
| U.S. Patent No. 4,419,595 to Reiner (“Reiner”)   | 1213                        |
| U.S. Patent No. 4,878,726 to Fatehi (“Fatehi”)   | 1214                        |

## II. BACKGROUND AND QUALIFICATIONS

5. I have 30 years of experience in the field of optical communication systems and components for such systems, including direct experience in the early development of fiber optic Wavelength Division Multiplexing components and

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Optoelectronic Integrated Circuit chips. A brief summary of my background and qualifications is provided in this section. My *curriculum vitae*, Exhibit 2025, provides additional details regarding my background and qualifications.

6. I became an Associate Professor in Electrical and Computer Engineering at the University of Delaware in 2002 and was recently promoted to Professor. I oversee the Optoelectronic Packaging and Integration laboratory at the University of Delaware, which researches advances in optical computing and communication, optical sensors, photovoltaics, and other photonic technologies. I am also the Director of the Mid-Atlantic Industrial Assessment Center, an award-winning center for research and development of energy systems and energy efficiency. The Center has won the 2012 U.S. Department of Energy Best Center award, and the 2015 U.S. Department of Energy Excellence in Applied Energy Engineering Research award.

7. I have served on professional committees including the IEEE Conference on Micro Electro Mechanical Systems and IEEE Optical Interconnect conferences. I am a Senior Member of the Institute of Electrical and Electronic Engineers (IEEE).

8. I earned a B.S. in Electrical Engineering from the University of California at Santa Barbara (1983) and an M.A. in Electrical Engineering from Princeton University (1985). I received my Ph.D. from Princeton University in

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1988, and worked at Bell Labs from 1988 until founding Aralight, Inc. in September, 2000. I performed research at Bell Labs in MEMS-based (Micro-Electro-Mechanical Systems-based) optical switches, much of which forms the basis of today's wavelength selective switches.

9. In September of 2000, I co-founded Aralight, Inc, where I was involved in the company's raising of \$10 million in capital and the growth of the company to 35 people. The company's product, an integrated optoelectronic fiber-optic transmit/receive module—showing 3x the bandwidth of previous such products—was based upon my inventions and followed on my research at Bell Labs. Aralight's product was demonstrated at the 2002 Optical Fiber Communication conference, at which time I entered academia. Aralight was later sold and its product forms the basis of today's Active Optical Cabling, which enables high-speed optical backplanes for switches and supercomputers.

10. I am the inventor (or co-inventor) on 87 issued U.S. patents. The technology of my patents covers optoelectronic devices and integration, optical systems, MEMS, and electro-optics. I have over 300 published papers and conference proceedings.

### **III. UNDERSTANDING OF PATENT LAW**

11. In forming the opinions expressed in this Declaration, I relied upon my education and experience in the relevant field of the art, and I have considered

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the viewpoint of a person having ordinary skill in the relevant art at the time of the invention. I am not a patent attorney, nor have I independently researched the law of patent validity. Attorneys have explained certain legal principles to me that I have relied on in forming my opinions as set forth in my Declaration, including principles of prior art, anticipation, and obviousness.

12. I have been advised, and it is my understanding, that patent claims in the IPR are given their broadest reasonable interpretation in view of the patent specification, file history, and the understanding of one having ordinary skill in the relevant art at the time of the invention.

13. I understand that in an *inter partes* review, the petitioner carries the burden of proving patent claim invalidity by a preponderance of the evidence on a claim-by-claim basis, based on either patents or printed publications. Each claim is analyzed independently. It is my understanding that when a party has the burden of proving a claim invalid by the preponderance of the evidence, the party must show that it is more likely than not that the claim is invalid.

14. I understand that a patent can be invalid for anticipation or for obviousness.

15. I understand that a patent claim may be invalidated as anticipated under § 102 of the patent statutes only if a single prior art reference discloses each and every limitation of the invention. To render a claim anticipated, the single

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reference must disclose each and every limitation of the claim either expressly or inherently, and must disclose every limitation of the claim as those limitations are arranged in the claim.

16. I understand that a limitation inherently exists in a reference only if that limitation is necessarily disclosed by the reference. The mere fact that something may result from a given set of circumstances is not sufficient to show inherency, as inherency cannot be established by probabilities or possibilities.

17. I understand that under § 103 of the patent statutes, a patent claim may be invalid as obvious in view of a combination of prior art references or in view of a single prior art reference. Obviousness is determined from the perspective of a hypothetical person of ordinary skill in the art (also known as a “POSITA” as discussed below in ¶23).

18. I understand that an obviousness analysis involves three factual inquiries: (1) the scope and content of the prior art, (2) differences between the prior art and the claims at issue, and (3) the level of ordinary skill in the art.

19. I understand that a patent claim may not be obvious if the prior art, either alone or in combination, and even when combined with the knowledge of one having ordinary skill in the art, does not disclose or suggest all of the limitations of a claim, *i.e.* that there remain differences between the prior art and the claim at issue. I also understand that a patent claim may not be obvious if a

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POSITA would not have modified or combined the prior art in a manner that would have disclosed or suggested all of the limitations of the claim.

20. In addition, I understand that a variety of factors are considered in determining whether an invention would have been obvious to a person of ordinary skill in the art. For example, a teaching, suggestion, or motivation in the prior art that would have led a person of ordinary skill in the art to modify a prior art reference or select multiple prior art references and combine them in such a fashion as in the claimed invention, may render an invention obvious. As well, a combination of elements that was obvious to try, for example, in light of market pressures, may render an invention obvious if there was a reasonable expectation of success. I understand that other factors can be considered in an obviousness analysis, including:

- a. whether known elements are combined using known methods to create predictable results;
- b. whether one known element is substituted for another known element to obtain predictable results;
- c. whether a known technique is used to improve a similar device in the same way;

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- d. whether a known technique is applied to a known device ready for improvement to yield predictable results; and
- e. whether design incentives or other market forces would have prompted a POSITA to implement predictable variations in known work in one field of endeavor for use of those predictable variations in either the same field or a different one.

21. I understand that an invention may not be obvious if the prior art reference(s) teaches away from the proposed modification or combination of prior art references. In addition, an invention may not obvious if the proposed combination creates “unpredictable results.” Also, an invention may not obvious if the proposed modification or combination would render the prior art device inoperable.

22. I further understand that a patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was independently known in the prior art.

#### **IV. PERSON OF ORDINARY SKILL IN THE ART**

23. I understand that the factors considered in determining the level of ordinary skill in the art include education and experience of persons working in the

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art, and the types of problems encountered in the art. Based on these factors, in my opinion, a person of ordinary skill in the relevant art of the '898 patent in the 2001-2002 timeframe has at least a bachelor's degree or equivalent in electrical engineering with optical engineering coursework, and five or more years of experience in optical transmission systems and associated components. I have been informed that this hypothetical person can be referred to as a "POSITA." For example, a POSITA would have education and/or experience sufficient to understand optical components for encoding, transmission, and decoding of data and related standards and concepts. My opinions contained in this declaration are given from the perspective of a person of ordinary skill in the art at the time of the July 9, 2001, the filing date of U.S. provisional patent application No. 60/303,932, and also as of July 3, 2002, the filing date of U.S. patent application 10/188,643, even if an opinion is expressed in the present tense. I perceive no relevant change in the level of ordinary skill between these dates.

24. As of the 2001-2002 timeframe, I satisfied this definition of a POSITA.

25. In preparing this declaration, I reviewed Dr. MacFarlane's declaration, Ex. 1202. He states in paragraph 19 that "a POSITA would have had at least a B.S. in Electrical Engineering or a related field with at least five years of experience in designing optical transmission systems, or an M.S. in Electrical

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Engineering or a related field. More education can supplement practical experience and vice versa.” I disagree slightly with this statement. An M.S. in Electrical Engineering can be completed without taking any optical transmission systems courses. In order to qualify as a person of ordinary skill in the art, a person having fewer than five years of experience in designing optical transmission systems would need to have taken extensive coursework in optical transmission systems while completing the M.S. program in Electrical Engineering.

## **V. CLAIM CONSTRUCTION**

26. I have generally given all the claim terms of their plain and ordinary meaning as it would be understood by a person of ordinary skill in the art at the time of the invention, giving consideration to the context provided by the patent specification. I have also considered the analysis and constructions set forth on pages 16-19 of the Board’s Institution Decision, and I have treated the terms “a transceiver card,” “a first optical fiber,” and “a second optical fiber” in the preambles of claims 1 and 14 of the ’898 patent as limiting according to the analysis on pages 18-19 of the Board’s Institution Decision.

## **VI. ANALYSIS – GROUNDS 1A AND 1B**

27. It is my opinion that Petitioners have not established unpatentability of claims 1 and 14, and their dependent claims, over a combination of Corke, Swanson, and Chikama. In particular, I believe a POSITA would not have

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modified Corke to provide “a first optical fiber” and “a second optical fiber” as set forth in the combination of elements recited in claims 1 and 14. Additionally, I disagree that a POSITA, reading these references, would have been motivated to arrange the detectors and control circuit of Corke’s optical control device onto a transceiver card in view of Swanson’s teaching that a transmitter and receiver could be arranged on a single card. Furthermore, it is my opinion that Corke does not disclose an energy level detector having a threshold indicating “a drop in amplitude” of an optical signal, as set forth in claims 10 and 14, and a POSITA would not have modified the proposed combination of Corke, Swanson, and Chikama to include that feature.

### **Corke’s Bidirectional Fiber Embodiments**

28. Corke’s embodiments showing bidirectional transmission and reception of optical communications, i.e., those embodiments showing both a transmitter port and a receiver port at a common node (including Fig. 4 and Fig. 7) disclose the use of a single “primary” fiber operating bidirectionally and a single “secondary” fiber, which can also operate bidirectionally. This means that optical signals can be transmitted in both directions on the bidirectional optical fiber. I will refer to each of these single, bidirectional fibers of Corke as a “bidirectional fiber.”

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29. Prior to the 2001-2002 timeframe, bidirectional optical fiber links were being explored primarily for cable TV and fiber-to-the-home. For this technology to be commercially feasible, costs must be kept as low as possible. Bidirectional optical fiber links are less expensive because they require fewer fiber components than multiple unidirectional optical fiber links in which optical signals are transmitted in only a single direction on a fiber.

30. Bidirectional optical communication may be done with a single bidirectional fiber as in Corke or with two unidirectional fibers as is shown in Swanson, which could be called a “fiber-pair.” In long distance communication systems employing optical amplifiers, typically fiber-pairs are used, since optical amplifiers generally have better performance unidirectionally. Corke does not have this concern. The communications path length for the applications Corke is concerned with, for example CATV, is short and, thus, Corke has no requirement to incorporate an optical amplifier in the communications path—Corke is not concerned with optical amplification and does not discuss optical amplifiers. Further, Corke’s scheme for selecting a route for transmission/reception requires bidirectional fibers and is inconsistent with the use of fiber-pairs, as I explain below.

31. Corke’s bidirectional fiber embodiments rely on detection of the signals *received* by a node of a communications link to determine which

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bidirectional fiber, or route, is used by that node to *transmit* signals. For example, Corke's Abstract states "In bi-directional communication systems, performance of a wave length moving in one direction through a route determines route quality for transmission in the other direction, as well." Corke, Abstract. Corke discloses similar use of the received signal performance to determine the route or fiber quality, and to determine selection of a transmission route based on the received signal performance, at various spots in the specification and claims, including at 3:1-6, 3:19-30, 4:50-62, 9:8-14, and 12:19-26.

32. Accordingly, when a primary bidirectional fiber is damaged or severed, and even a single wavelength suffers from signal degradation, a node in Corke's system can decide to switch to a secondary route for transmission and reception of optical signals based on the detected quality of received signals. Corke, 1:11-17, 5:42-44.

33. This feature of using signals received by a node, in order to control how signals are transmitted by the node, is reflected in preferred embodiments of Corke. With regard to Fig. 7, Corke notes, "If the route A cable is disturbed or severed, the 1550 nm monitor system detects that condition and automatically switches to route B. The 1330 nm signal *travelling in the opposite direction* is also directed on to the route B cable." Corke, 9:11-14. Similarly, Corke states regarding Fig. 8, "In this embodiment if route A should fail it would be detected by

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the detector 44, which is monitoring the signals from the transmitter 30. The control device would make the digital comparison, as described above, and upon determining the intensity at the detector has fallen below the specified digital threshold value it would switch the switch to access route B, (assuming that route B monitored status was acceptable). The signal from the *transmitter 130* would then *automatically be diverted* through route B to the receiver 151, while the signal from transmitter 30 is received at receiver 50 through route B.” Corke, 9:33-45.

34. Corke also teaches monitoring the performance of the fiber on a wavelength-by-wavelength basis to sense wavelength-specific performance degradation. Corke, 8:31-49. Corke specifically teaches that “monitoring the combined optical power (at 1300 and 1550 nm) by a single detector can lead to serious signal failure at one wave length, leading to poor BER [bit error rate] performance being undetected.” Corke, 8:31-35. To overcome this problem, Corke teaches monitoring the performance of each wavelength individually by separating the combined signal and then detecting the intensity of the signal at each wavelength, 1300 nm and 1550 nm. Corke, 6:22-40; Fig. 2, Fig. 4. In this way, Corke discloses and encourages selecting the transmission and reception route based on actual measurements of wavelength-by-wavelength performance.

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35. Thus, a POSITA would also understand Corke's teaching to monitor the performance of each wavelength individually by separating the combined received signal and then detecting the intensity of the signal at each wavelength, 1300 nm and 1550 nm. Based on that wavelength specific performance, Corke determines which route to select for both transmission and reception of optical signals because both transmission and reception signals are carried on the same bidirectional fiber. Corke refers to this scheme as "independent monitoring of each wave length in both routes A and B." Corke, 8:51-52.

36. As an example of how this teaching improves over the prior art's method of monitoring a combined optical power level, Corke explains that a complete loss of the 1550 nm signal on route A could reduce the combined optical power level by 50%, and that this reduction "would not, under typical operations conditions of a digital data transmissions link, cause the route A monitoring system to switch or alert the switch control system." Corke, 8:42-49.

37. Corke's method of deciding which transmission fiber to use necessarily requires bidirectional fibers, not fiber-pairs. In Corke's system, the decision to select the route for transmission/reception occurs entirely at a single node co-located with the switch 7/48 (see Corke, Figs. 1-9), while the other node implements a coupler between transmitter/receiver ports and the fibers of Route A and Route B. The node's switch setting, and route selection, is determined by the

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node's control circuit based only on information in that node, specifically including a measurement of the average intensity of optical signals received by that node. A POSITA would understand that Corke could not use a measurement of the average intensity of *received* optical signals to make a decision about the wavelength-dependent quality of a transmission fiber unless the characteristics of the received signals were linked to the characteristics of the transmission fiber. A bidirectional fiber used for both transmission and reception, like that in Corke's embodiments, physically links those wavelength-dependent characteristics, and thereby provides a direct indication of the wavelength-dependent quality of the transmission fiber based on the received signal qualities. A POSITA would regard a system having plural unidirectional fibers, or fiber-pairs, per route as having an insufficient link between the characteristics of received signals and the characteristics of the transmission fiber. In this situation, guided by Corke's teachings, a POSITA would not have used the quality of the received signal to determine the quality of a transmission fiber, including for wavelength-dependent properties. In such a system, there would be no direct monitoring by the transmitting node of any characteristic of the unidirectional transmission fiber at all. This runs contrary to Corke's teaching that measurements of the route fibers should be made on a wavelength-by-wavelength basis. Accordingly, use of

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bidirectional fibers in Corke's bidirectional communication embodiments is necessary.

38. The core of Corke's invention—performing separate monitoring of both wavelength channels along the same fiber—is based on Corke's realization that prior art solutions that monitored the sum of the channels were insufficient to accurately characterize the quality of the fiber. As he states in col. 8, lines 31-41, ***“it has been realized*** that this feature of monitoring the combined power (at 1300 and 1550 nm) by a single detector can lead to serious failure at one wave length, leading to poor BER performance being undetected. An example of such a scenario would be the so-called ‘back-hoe’ fade which would cause significant loss at 1550 nm as a buried cable was being bent (by inadvertent contact by an earth excavating machine) while minimal effect at 1300 nm would be observed.” (emphasis added). Corke realized that two wavelengths traveling down the same fiber can experience different failure effects under such conditions, and so requires separate monitoring of each wavelength.

39. If two wavelengths traveling down the same fiber can experience different effects due to back-hoe fade, so much so that Corke made his invention to independently monitor both wavelengths on a single fiber, it follows that two fibers of a fiber-pair could also experience different effects. Dr. MacFarlane confirmed this opinion at deposition. Ex. 2032, 83:8-16. Corke does not suggest substituting

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out the single bidirectional fibers for fiber-pairs, since only the receiving fiber is monitored, and nothing is known of the transmitting fiber's quality. Just as Corke realized for two wavelengths traveling down a single fiber, a POSITA would have realized that a fiber-pair could encounter different failures, and particularly that the transmission fiber could experience complete failure while the receiving fiber could experience "minimal effect." A POSITA reading Corke would understand that Corke's system would provide no benefit to use such a fiber-pair system and, in fact, a fiber-pair system would be far less reliable since the transmitting fiber could not be monitored.

40. Accordingly, a POSITA would understand that Corke's system embodiments showing a transmitter port and receiver port at a common node require bidirectional fibers since a node in Corke determines if a fiber is acceptable for transmission, and the node makes this determination by monitoring the received signals from the fiber, evaluating the intensity of these received signals, and making a determination whether the fiber is acceptable for transmission of signals. Thus, Corke's system requires reception and transmission along the same bidirectional fiber.

41. Given Corke's teaching, a POSITA **would not** have replaced Corke's single bidirectional fiber of Route A with two unidirectional fibers, and would not have replaced Corke's single bidirectional fiber of Route B with two unidirectional

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fibers. As I already explained above, this substitution was contrary to Corke's teachings, would have increased the cost of Corke's system, would have made it less reliable, and these consequences would have been undesirable to a POSITA.

42. In particular, this substitution of elements would have eliminated the ability of a node in Corke to determine if a route's fiber is compromised by monitoring received signals received over that same fiber. Corke teaches to monitor the performance of each wavelength individually by demultiplexing the combined received signal and then detecting the intensity of the signal at each wavelength, 1300 nm and 1550 nm. Corke explains that this process of independent monitoring allows for improved detection of a signal failure at one wavelength over combined signal monitoring. The substitution of two unidirectional fibers for each one of Corke's bidirectional fibers would cause Corke's control unit 10 to select a route for signal transmission without any data indicating whether the unidirectional transmission fiber was experiencing signal loss. This modification directly contradicts Corke's teaching of selecting a route for transmission based on more data rather than less (or none at all). This modification eliminates Corke's ability to select a fiber for transmission with a significantly reduced risk of signal degradation or performance loss.

43. I understand that Petitioners propose to modify Corke based on Swanson's disclosure that to "achieve bidirectional transmission, either two fibers

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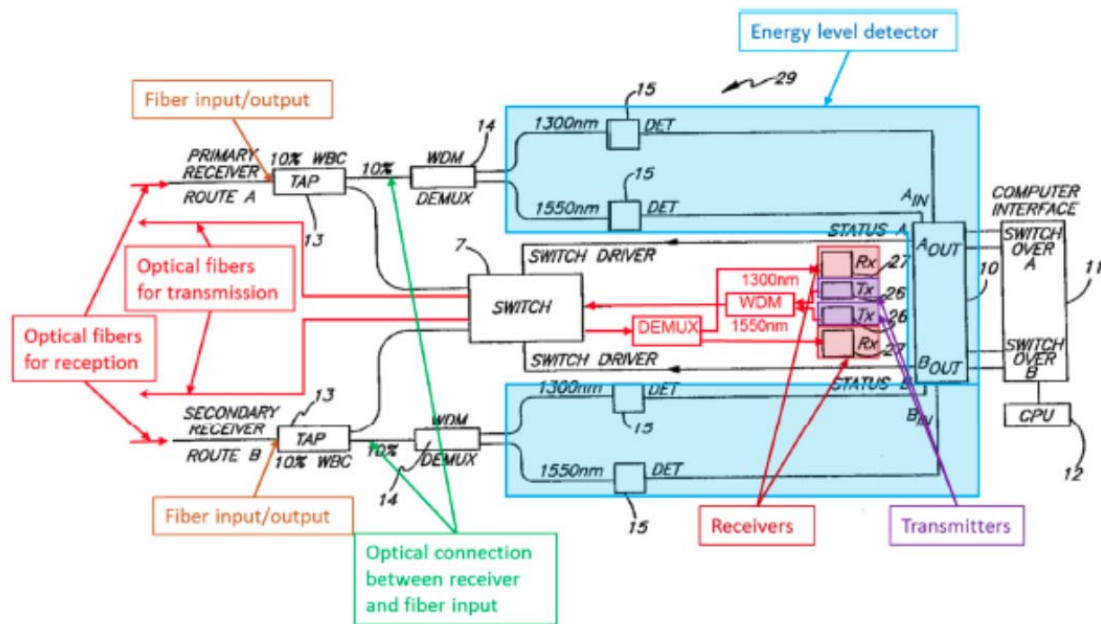
can be used (one transmitting in each direction), or one fiber can be used with the eastbound and westbound traffic on different wavelengths.” Ex. 1202, ¶¶59, 122.

This is a quotation taken from Swanson, 4:19-24, and it also appears in the Petition, pp. 9 and 21. It is also relied upon by the Board in the Institution Decision (pp. 25, 29-30). However, this statement is overly simplistic, and fails to consider that there are instances where one bidirectional fiber may include advantages over a fiber-pair. Corke is precisely one of these instances for the reasons I have discussed.

44. Dr. MacFarlane states, “a POSITA would have understood that separate, unidirectional optical fibers could be used for transmission and reception, as an alternative to using the same optical fiber for bi-directional communication. A POSITA would have been motivated, for example, by the disclosure of Swanson, which, as I have noted previously, explains that, to ‘achieve bidirectional transmission, either two fibers can be used (one transmitting in each direction), or one fiber can be used with the eastbound and westbound traffic on different wavelengths.’” Ex. 1202, ¶122 (citing Swanson, 4:21–24). Dr. MacFarlane states that this modification of Corke based on Swanson “constitutes a combination of known prior art components ... according to known methods ... to yield predictable results ... .” Ex. 1202, ¶126.

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45. Dr. MacFarlane also included an annotated version of Corke's Figure 4 in his declaration, with separate optical fibers for transmission and reception shown connected to switch 7. Ex. 1202, ¶122. The Board referred to this annotation as "Annotated Corke Figure 4" in its Institution Decision at page 27, and I will do the same. I include Dr. MacFarlane's Annotated Corke Figure 4:



46. As I have explained above, Corke's system relies upon bidirectional fiber to function, and Dr. MacFarlane's statement that "separate, unidirectional optical fibers could be used [in Corke] for transmission and reception, as an alternative to using the same optical fiber for bi-directional communication" fails to recognize the importance of bidirectional fiber in Corke. A POSITA working on Corke's system would find the use of separate, unidirectional fibers to be irrelevant to Corke and contradictory to Corke's teaching of selecting a route for

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transmission based on the fiber's performance, as determined by the intensity of the signal received from the same fiber, measured at each wavelength.

47. A POSITA would understand that Corke's use of bidirectional fibers, coupled with Corke's use of the received signal performance measurements to determine a transmission route, provides benefits over the use of separate transmit and receive fibers that are not accounted for in Swanson's overly simplistic statement. Corke's interaction between its receive and transmit functions allows it to provide monitoring of the same fiber used for reception and transmission. Thus, a POSITA would understand that Corke's use of bidirectional fibers increases the likelihood that Corke is able to transmit over a fiber that will not fail or otherwise degrade the transmission.

48. Corke's reliable transmission safeguard is lost in Petitioners' modification. A POSITA would understand Dr. MacFarlane's Annotated Corke Figure 4, representing his proposed modification of Corke, to isolate the reception and transmission sub-systems. By isolating the sub-systems, the proposed combination does not monitor the transmission fibers, either as a whole or for wavelength-dependent degradation.

49. Dr. MacFarlane stated at deposition that "one has to be mindful" that "switch 7 in the annotated Corke figure 4 is being asked to do more things than the switch in figure 4 of the '917 patent." Ex. 2032, 67:11-15. Nevertheless, Dr.

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MacFarlane fails to explain in his declaration how switch 7 would operate to direct optical signals for transmission in Annotated Corke Figure 4. He stated in deposition that he does “not explicitly describe the operation of switch 7 in annotated figure 4 in [his] declaration.” Ex. 2032, 68:20-22.

50. I believe that the proposed modification of Corke as reflected in Annotated Corke Figure 4 is wholly inconsistent with Corke’s disclosure, because control circuit 10 and switch 7 would be selecting an optical fiber for transmission without data indicating whether the selected optical fiber is experiencing wavelength-specific degradation of the transmitted signal. In fact, the optical device in Annotated Corke Figure 4 would not possess information needed to determine whether a transmission fiber is degraded. Thus, a POSITA would not find it obvious how modify switch 7 in optical device 29 Corke Annotated Figure 4 “to do more things than the switch in figure 4 of the ’917 patent” (as stated by Dr. MacFarlane at deposition) since the optical device 29 lacks information needed to make an adequate decision about transmission fiber quality on route A and route B.

51. Accordingly, a POSITA would not have been motivated to modify Corke in view of Swanson’s disclosure regarding separate transmit and receive fibers. This would have eliminated Corke’s ability to determine if a fiber used for transmission is compromised by monitoring received signals over that same fiber, and this would have been inconsistent with Corke’s teaching to select routes for

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transmission and reception based on the measured integrity, on a wavelength-by-wavelength basis, of the bidirectional fiber on each route.

### **Corke's Amplitude Modulation**

52. Claim 14 of the '898 patent requires "an energy level detector configured to measure an energy level of the second optical signal, the energy level detector including a threshold indicating a drop in amplitude of the second optical signal." Claim 10 of the '898 patent requires that the "plurality of thresholds" first recited in claim 1 must "indicate a drop in amplitude of a phase modulated signal." I understand Petitioners contend that the "intensity" detected by Corke's detector 15, and the "pre-set level" corresponds to the claimed "threshold indicating a drop in amplitude of the second optical signal" of claim 14. Petition, 33; Institution Decision, 36. Petitioners refer to Corke's "reference level" and "pre-set level" in a similar analysis of claim 10. Petition, 38-39.

53. Corke's detector threshold is compared to an "average intensity." Corke explains that, "[t]he detector is selected to detect the average intensity of the signal at the selected wave length for comparison with a threshold value of the minimum signal intensity acceptable." Corke, 2:47-49. A POSITA would understand that the threshold for the "minimum signal intensity acceptable" refers to a minimum average intensity threshold.

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54. I disagree that Corke's average intensity threshold satisfies the requirement for a threshold or plurality of thresholds "indicating a drop in amplitude." Determining whether an "average intensity" in Corke is less than a threshold does not suggest a threshold indicating a "drop in amplitude."

55. In systems that employ amplitude modulation, also known as intensity modulation, the amplitude of the optical signals drops and rises based on the information to be transmitted. Generally, in an amplitude modulation system, the amplitude or intensity of a carrier signal is changed between a low and high state to communicate a zero or a one.

56. It is my opinion that Corke's system employs a form of amplitude modulation. Phase modulation systems require more components and more complex components, and thus are more costly. Corke is mainly considering applications such as cable TV ("CATV," col. 10, line 48), for which costs must be minimized. Indeed, Corke is greatly concerned with reducing cost, as discussed at col. 9, line 18, and col. 6, line 63. Thus, my opinion is that Corke was contemplating an amplitude modulation system, or intensity modulation system.

57. Because the purpose of Corke's intensity threshold is to determine a fault, it would be meaningless for the threshold to detect a "drop in amplitude" of an amplitude-modulated optical signal. Under normal operating conditions of an amplitude-modulation scheme, a signal drops in amplitude regularly, to a low state,

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to communicate the data encoded in the signal to the receiver (not to an energy level detector). Corke's detector detects "average intensity" (2:47-49), provides a threshold to determine if it falls below the "minimum signal intensity acceptable," and does not set any threshold to detect a "drop in amplitude." The use of an "average intensity" threshold in Corke allows Corke to be used in systems that employ amplitude modulation. A POSITA could set the length of time of the averaging process to be long enough to rule out variation in intensity due to normal operation.

58. Petitioners offer no reason why a POSITA would have modified Corke's average intensity monitoring to instead detect a "drop in amplitude." Moreover, removing Corke's feature relating to "average intensity," and replacing it with a threshold based on a drop in amplitude, would not have been implemented by a POSITA because this change would have eliminated Corke's monitoring ability in a system that uses amplitude modulation.

#### **Swanson's Transceiver Card**

59. The claims of the '898 patent require many components, including a transmitter having a laser, a receiver, and an energy level detector, to be arranged on a single transceiver card. These features are not disclosed in Corke, Swanson, or Chikama. The Petitioners argue that "Corke's optical device could be

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implemented in a physical transceiver card,” in reliance on Swanson and Dr. MacFarlane’s testimony. Petition, 21-22.

60. Corke discloses an optical communication system 1 (Corke, 5:38) having a communication monitoring and control device 6 (Corke, 5:46). Corke teaches that optical fibers 4 and 5 are not part of the communication monitoring and control device 6, but instead are “connected” to the device 6. Corke, 5:44-45. In describing the communication and monitoring device 6 of Fig. 2, Corke explains that the device 6 connects to primary and secondary optic fibers 4 and 5 “at ports” (Corke, 6:3-4), and that signals passing through the wave division multiplexer 16 are received at “ports of receivers 8(a) and 8(b).” Corke, 6:18-21. I understand that Dr. MacFarlane agrees that tap couplers 13 in Fig. 2 of Corke “connect the device to respective primary and secondary optical fibers” as described by the Board in its Institution Decision. Ex. 2032, 26:8-18. Just as Corke is teaching that fibers 4 and 5 are not part of the communication monitoring and control device 6 and instead are connected to it by ports, I believe his use of receiver “ports” is also teaching that the receivers to which these signals are delivered are connected to the communication monitoring and control device 6 via ports, or external connection points.

61. In describing the system “20” of Fig. 3 and the optical communications control device 29 of Fig. 4, Corke discloses “separate transmit

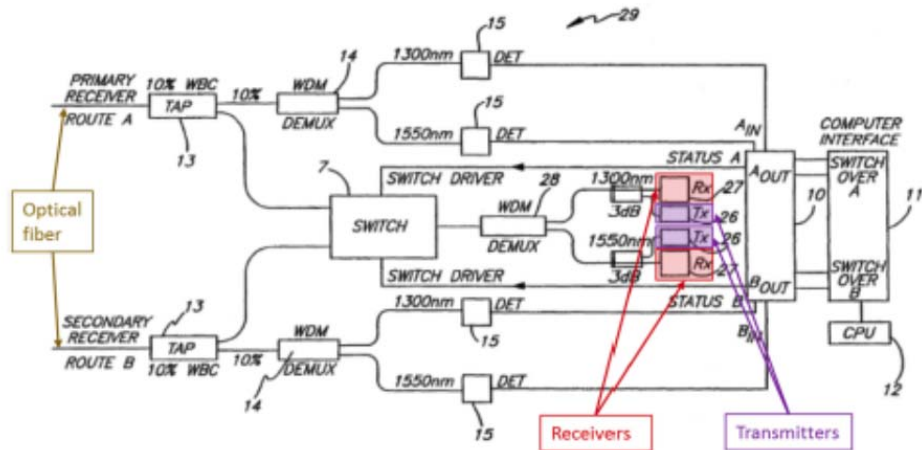
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and receive ports 26 and 27.” Corke, 7:64-65, Figs. 3-4 (identifying the transmit and receive ports with the shorthand “Tx” and “Rx”); Corke, 7:60 (identifying “transmit ports 21 and receive ports 22”). I note that the ports 26 and 27 are expressly referred to as being “separate” (Corke, 7:64-65) and the term “ports” here would be understood by a POSITA to be optical ports for connecting optical media consistent with Corke, 7:48-52, and with the citations I’ve included in my previous paragraph. Additionally, Corke distinguishes between the “optical monitoring system” and “receiving telecommunications equipment” in claims 14 and 16 (Corke, 12:65-13:4; 13:16-22), and reinforces this difference in the specification, stating “The same monitoring and control equipment can readily be adapted to protect a route or receiver equipment from excessive optical energy at all or any one wave length.” Corke, 10:67-11:2. This confirms to me that the monitoring and control equipment is taught by Corke to be separate from the transmit and receive equipment. While Corke does refer to “transmit circuits 26” in reference to Corke’s Fig. 4 (Corke, 8:5-10), a POSITA would understand that statement as distinguishing Fig. 4 from the device 6 of Figs. 1a and 1b of Corke, which does not include transmit capabilities.

62. Dr. MacFarlane relies on Swanson’s disclosure of a single card possessing both a transmitter and receiver for his opinion that Corke could include a single card on which a transmitter and receiver are both arranged. Ex. 1202, ¶59.

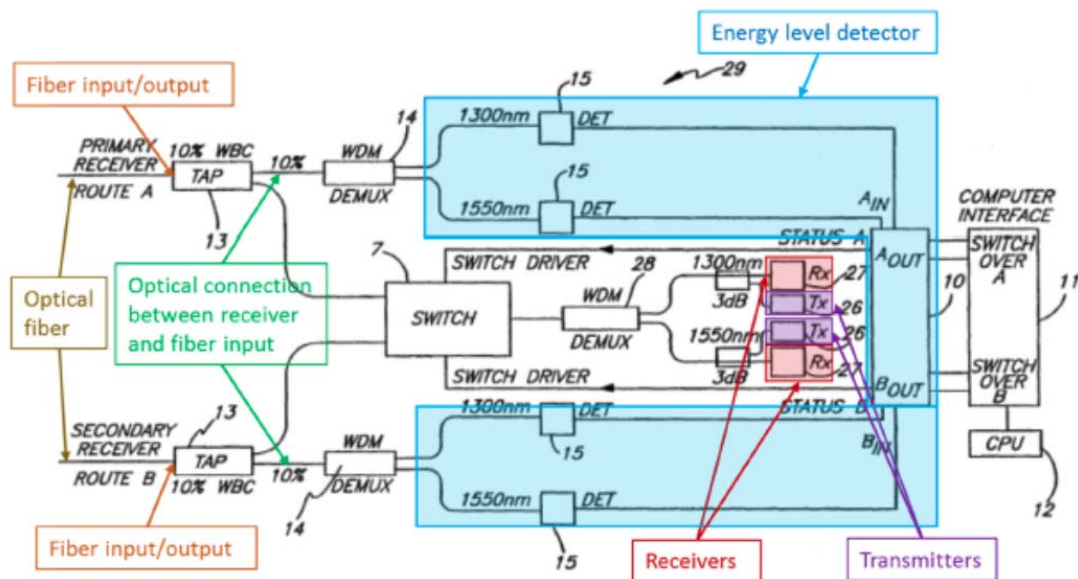
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Swanson specifically discloses that a “bidirectional interface may consist of one card having both a transmitter and a receiver.” Swanson, 4:31-33. Even in the Petitioners’ own annotations, Corke’s “transmitter[s] and receiver[s]” are only a small portion of Corke’s optical device 29.



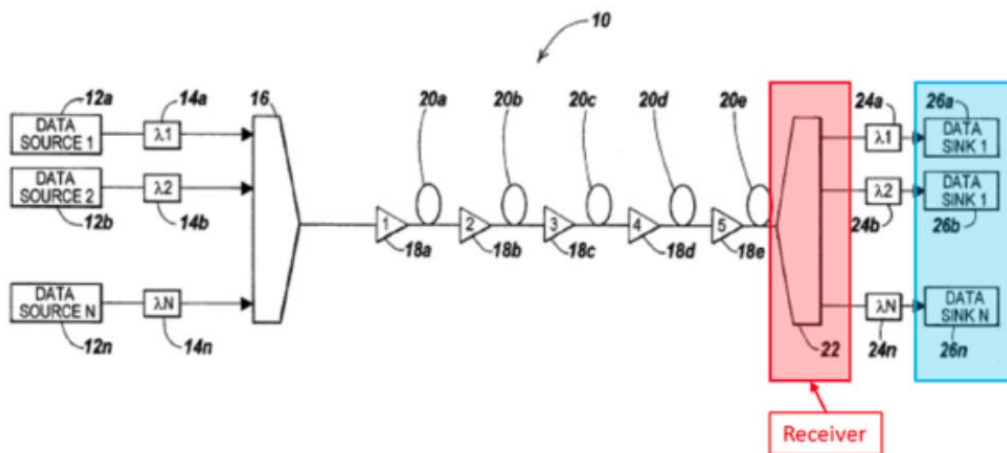
Petition, 21. Dr. MacFarlane includes a similar annotation of Corke’s FIG. 4, labeling only the transmit and receive ports 26 and 27 as transmitters and receivers. Ex. 1202, ¶43.

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Corke, FIG. 4 (annotated)

Dr. MacFarlane then includes an annotated version of Swanson's FIG. 1, with the "Receiver" 22 of Swanson identified with a pink box. Ex. 1202, ¶59.



Swanson, FIG. 1 (annotated)

According to Dr. MacFarlane, Swanson discloses a single card possessing both a transmitter and receiver, and from that limited disclosure, Dr. MacFarlane states

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that a POSITA would have been motivated to combine Corke and Swanson “such that the [entire] transceiver optical device in [] Corke’s FIGS. 2-4 are on one physical card, as disclosed by Swanson.” Ex. 1202, ¶123.

63. Notably, in his annotation of Swanson’s FIG. 1, Dr. MacFarlane excludes the optical-to-electrical converters 24a-24n from the “Receiver” in Swanson’s FIG. 1. This is important because when Dr. MacFarlane proposes to modify Corke in view of Swanson, he proposes to include Corke’s Rx 27 and Tx 26 ports (or even a receiver and transmitter) on a common transceiver card, along with other components of Corke’s optical device not disclosed or suggested by Swanson. In essence, Swanson only speaks to the pink and purple boxes of the annotated Corke Fig. 4. But Dr. MacFarlane interprets Swanson’s narrow disclosure that “one card” can have “both a transmitter and a receiver” as a broad teaching to include the entire optical device 29, including the switch 7, detectors 15, control circuit 10, and CPU 12, in Corke’s FIGS. 2-4 “on one physical card, as disclosed by Swanson.” Ex. 1202, ¶123.

64. That is not what Swanson teaches. I only find two instances of the word “card” in Swanson, both occurring in the sentences found at 4:31-34 of Swanson. Swanson does not disclose arranging Corke’s detectors 15 and control circuit 10 on a transceiver card with a transmitter and a receiver. In fact, even Dr. MacFarlane’s annotation of Swanson’s system excluded the optical-to-electrical

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converters 24a-24n from the “Receiver” in Swanson’s FIG. 1. At deposition Dr. MacFarlane mentioned that Swanson’s use of forward error correction (FEC) also suggested an energy level detector. Ex. 2032, 50:14-52:3. But Swanson also distinguishes between Receiver 22 and the FEC decoder 42, and since FEC decoder 42 is downstream of the optical-to-electrical converters 24a-24n, it receives electrical signals and not optical signals.

65. Thus, the manner in which Dr. MacFarlane proposes to combine Corke and Swanson would result, at most, in a system with the optical transmit and receiver ports of Corke’s module connected to corresponding ports on Swanson’s card. I disagree that a POSITA faced with Corke and Swanson would interpret Swanson’s limited disclosure about a transmitter and a receiver arranged on a single card as a broad teaching to arrange Corke’s entire optical device 29 on a single card. This conclusion does not follow from Swanson’s disclosure. It also does not follow from Corke’s disclosure, which seeks to keep the transmit and receive ports “separate,” and to keep the monitoring and control device/equipment separate from the transmit and receive equipment as I explained above.

### **Mock**

66. Claims 13 and 25 of the ’898 patent recite, on the claimed transceiver card of claims 1 and 14 respectively, “a first splitter splitting the optical signal to the energy level detector, and a second splitter for an OTDR.” ’898 patent, 7:34-

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36; 8:40-42. Petitioners and Dr. MacFarlane rely on Mock WDMs (wave division multiplexers) to disclose a splitter for an OTDR. Petition, 41; Ex. 1202, ¶76.

67. Mock teaches that the test signal control circuit 24 responds to a drop in the data signal output from diode 21 by “launching a 1.5  $\mu\text{m}$  test signal on line 16 through [WMD] 26.” Mock, 5:50-56. As shown in Mock’s FIG. 1, WDMs 22, 26, and 28 are each arranged in an SLGX switch assembly 19. Mock’s SLGX switch assembly “houses [the] monitor photodiode 21” and therefore it is clear to me that the WDMs 22, 26, and 28 are arranged in a separate housing, referred to as the SLGX switch assembly, and are not co-located with any transmitter or receiver on a transceiver card. This is consistent with my understanding of LGX assemblies, which were designed to be self-contained components to be added to a modular rack system via input and output ports. Claims 13 and 25 require the second splitter for the OTDR to be on the transceiver card, and it is clear to me that components arranged in an SLGX assembly are not on a transceiver card, and would not have been removed from the assembly by a POSITA to be added to a transceiver card.

68. Dr. MacFarlane states that “Mock demonstrates that the transceiver card can include a second splitter for an OTDR.” Ex. 1202, ¶186. But as I noted above, Swanson discloses only arranging a transmitter and receiver on a transceiver card. Neither Corke, Swanson, Chikama, nor Mock discloses

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relocating components for an OTDR, including components arranged in an SLGX switch assembly, onto a transceiver card. In my opinion, it would not have been obvious to relocate the WDMs of Mock from an SLGX switch assembly and arrange them on a transceiver card.

## **VII. ANALYSIS – GROUNDS 2A, 2B, AND 2C**

69. It is my opinion that Petitioners have not established unpatentability of unpatentability of claims 1 and 14, and their dependent claims, over Choy, DeSalvo, and Takahashi. In particular, I believe a POSITA would not have been motivated to modify Choy to include an EDFA preamplifier or filter in the manner proposed by Dr. MacFarlane according to DeSalvo's teachings.

70. As a preliminary matter, Choy and DeSalvo are respectively directed to fundamentally different technologies. Dr. MacFarlane introduces Choy in paragraphs 77-86 of his declaration, and quotes Choy, 2:37-47 in paragraph 78: Choy describes "a wavelength division multiplexer (WDM) unit that includes a plurality of Input/Output cards (IOCs). Each IOC is bidirectionally coupled to I/O specific media (fiber or copper) and to two coaxial cables. Also bidirectionally coupled to the coaxial cables are a plurality of Laser/Receiver Cards (LRC). ... Each LRC is bidirectionally coupled by two single mode fibers to an optical multiplexer and demultiplexer, embodied within a grating. An input/output port of the grating is coupled to a fiber link that enables bidirectional, full duplex data

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communications with a second WDM at a distance of up to approximately 75 kilometers.” Ex. 1202 (quoting Choy, 2:37-47). In essence, Choy’s fiber link transmits a multiplexed signal, which is then received by a WDM unit’s grating and demultiplexed into demultiplexed optical signals. The demultiplexed optical signals, each having different wavelengths, are each passed to a corresponding LRC for processing.

71. Unlike in Choy, DeSalvo’s printed circuit card assembly 31 receives a multiplexed signal, and amplifies that multiplexed signal with the EDFA preamplifier 32 before passing that signal through the tunable bandpass filter 34. The desired wavelength is then filtered using the tunable bandpass filter 34 and processed on the printed circuit card assembly 31. DeSalvo is showing a form of architecture, different than the use of demultiplexers in Choy’s grating, that a POSITA would recognize as Broadcast-and-Select. The concept of Broadcast-and-Select was developed as an alternative to demultiplexers that use a grating to separate optical signals by wavelength. In a Broadcast-and-Select system, instead of passing through a grating, the multiplexed signal can be sent into a star coupler, which splits it and sends each split signal to a tunable filter (as is shown in Figure 1 of DeSalvo), where the tunable filter selects the desired wavelength. This is a completely different architecture than what is shown in Choy (Figure 1), using grating demultiplexers in the WDM units 12, and which can be referred to as a

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Mux/Demux architecture. Broadcast-and-Select is more complicated than Mux/Demux, since Broadcast-and-Select requires additional measures, including optical amplification, to counteract the effect on the multiplexed signal from the need to split the multiplexed signal to each individual receiving node. But Broadcast-and-Select also offered a potential advantage over Mux/Demux because each receiving node could be reconfigured to receive a different wavelength by tuning its filter. Generally today, Mux/Demux is employed since optical amplifiers are expensive, and use a lot of power. When wavelength reconfigurability is required, an optical wavelength switch can be employed in a Mux/Demux system.

### **Choy's Mux/Demux System**

72. As introduced above, Choy's WDM unit includes a plurality of Input/Output cards (IOCs), which are bidirectionally coupled to Laser/Receiver Cards (LRC) via coaxial cable. Each LRC is bidirectionally coupled by two single mode fibers to an optical multiplexer and demultiplexer, embodied within a grating.

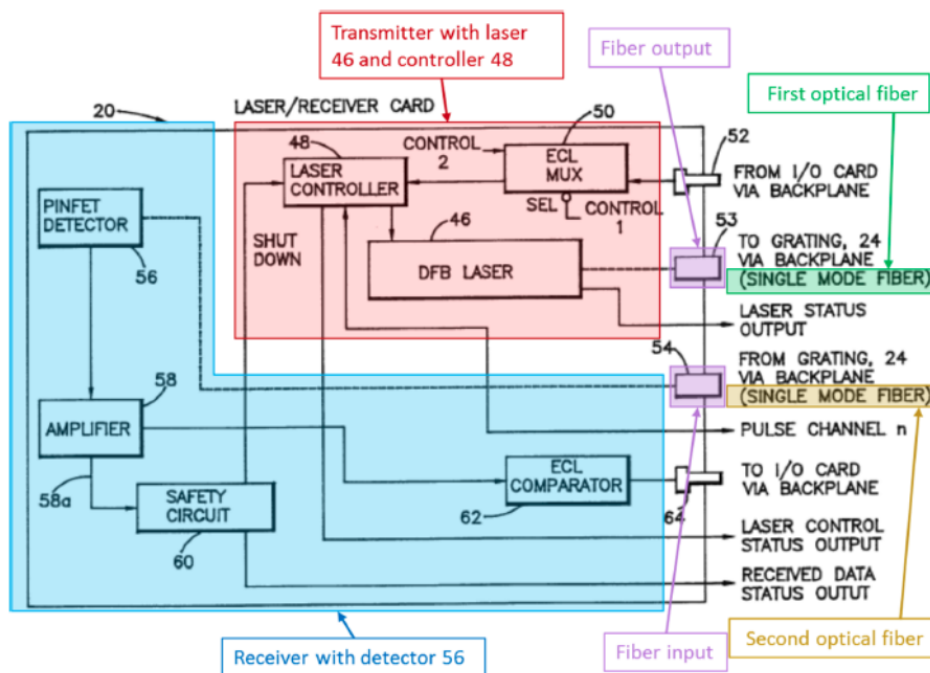
73. Focusing on the optical signals received at Choy's LRC 20, Choy discloses that: "LRC 20 receives, via connector 54, a demultiplexed optical signal from the grating 24. This optical signal is applied to a suitable optical detector 56, such as an avalanche detector or a PINFET detector, which converts the optical signal into an electrical signal. The electrical signal that is output from the detector

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56 is further amplified by amplifier 58 and is applied to an LRC safety circuit 60 and, via ECL comparator 62 and connector 64, to the ECL input buffer 38 of the associated IOC 14. The input signal at the IOC 14 is applied to the media specific transmitter 32 and connector 30 for application to the attached communications link.” Ex. 1202, ¶82 (quoting Choy, 6:25-36).

74. At deposition, I understand that Dr. MacFarlane was asked about Choy’s disclosure at 9:20-24, and after evaluating this disclosure, he concluded that Choy is disclosing that its WDM system uses intensity or amplitude modulation. Ex. 2032, 122:9-123:11. I agree.

75. Dr. MacFarlane’s annotated version of Choy’s FIG. 3A, from ¶82, is included below:

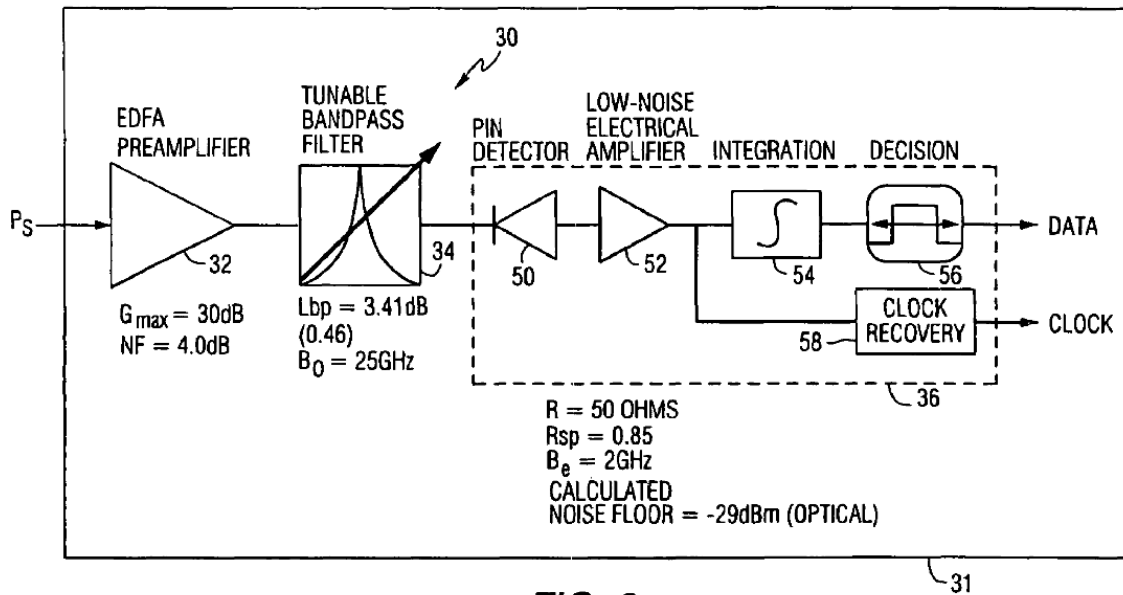


Choy, FIG. 3A (annotated)

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### DeSalvo's Broadcast-and-Select System

76. Unlike Choy, DeSalvo's printed circuit card assembly 31 receives a multiplexed signal, amplifies it, and uses the tunable bandpass filter to select the optical signal having the desired wavelength. Dr. MacFarlane introduces DeSalvo in paragraphs 87-96 of his declaration. Fig. 2 of DeSalvo, reproduced below, depicts the arrangement of DeSalvo's printed circuit card assembly 31, which receives the multiplexed signal, and amplifies that multiplexed signal with the EDFA preamplifier 32 before passing that signal through the tunable bandpass filter 34.



77. Importantly, DeSalvo's printed circuit card assembly 31 receives and processes multiplexed signals. DeSalvo, 4:44-45 ("The receiver, in one aspect of

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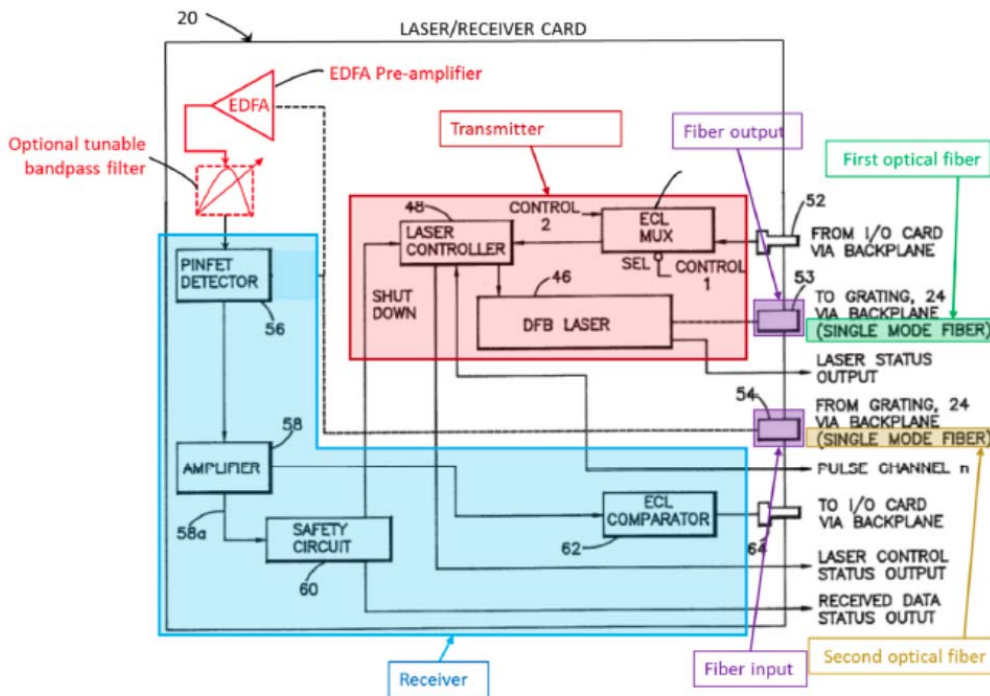
the invention, uses a single input fiber with multiple wavelengths.”). The multiplexed signal on the input fiber is then amplified using an EDFA preamplifier. DeSalvo, 4:45-47 (“a low noise, gain flattened erbium doped fiber amplifier that acts as a preamplifier”). After the multiplexed signal is amplified, the signal is demultiplexed. DeSalvo, 4:47-48 (“a low loss demultiplexer with minimal variation in channel-to-channel output power”). The demultiplexing is performed by the “tunable bandpass filter” element 34 in DeSalvo’s Fig. 2. DeSalvo, 6:49-57. A receiver, which includes a PIN detector, acts on the demultiplexed signal. DeSalvo, 4:49-50 (“A receiver array then follows and includes in each receiver a PIN detector and high speed electronics”).

78. Unlike Choy’s WDM embodiments using the grating 24 to multiplex/demultiplex input and output signals, DeSalvo discloses a bandpass filter 34 that receives a multiplexed signal, and selects a single channel from the multiplexed signal. DeSalvo, 5:45-46.

### **Choy and DeSalvo**

79. Dr. MacFarlane includes in his declaration another annotated version of Choy’s FIG. 3A, modified to include DeSalvo’s EDFA Preamplifier and the optional tunable bandpass filter. Ex. 1202, ¶222. These components are added to Choy’s LRC 20 after the connector 54, but before PINFET Detector 56, as shown:

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Choy's laser/receiver card (LRC) modified with EDFA preamplifier and optional bandpass filter

80. Dr. MacFarlane proposes to add DeSalvo's EDFA preamplifier to Choy's LRC 20, which receives demultiplexed signals output from the demultiplexer in grating 24. Choy's connector 54 on the LRC 20 does not receive signals in multiplexed form. Ex. 2032, 117:6-10. I note that this arrangement of an EDFA Preamplifier in Choy's LRC is inconsistent with DeSalvo's Broadcast-and-Select scheme, and also inconsistent with Choy's LRC disclosures.

81. Relying on Dr. MacFarlane's declaration, the Petition describes DeSalvo's preamplifier-bandpass filter arrangement (see Petition, 14):

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With an objective to “increase the signal level well above the receiver noise floor and increase the receiver sensitivity,” DeSalvo includes, in each optical receiver and in addition to repeater 16 on the trunk fiber, an optical preamplifier based on EDFA technology, as this counters demultiplexing losses. *Id.*, 5:5-9, 5:24-45, FIGS. 1, 2. *See also* Dec., ¶¶93-94.

82. It is my opinion that a POSITA, faced with Choy and DeSalvo, would not have been motivated to incorporate DeSalvo’s EDFA preamplifier into each LRC of Choy. First, Dr. MacFarlane points to DeSalvo’s teaching that the use of an EDFA preamplifier allows the use of PIN detectors as an optical-to-electrical converter, instead of avalanche photo diodes. Ex. 1202, ¶95 (quoting DeSalvo, 5:10-12). But Choy discloses use of a PINFET detector 56, and like an avalanche detector, a PINFET detector includes amplification as well as detection functionality. See Ex. 2032, 117:16-118:13.

83. A POSITA would interpret Choy’s teaching to use either a PINFET detector 56 or an avalanche detector as a suitable detector (Choy, 6:27-29) as disclosing that the detector itself should include amplification. DeSalvo then teaches that in lieu of an avalanche detector, a PIN detector (lacking amplification) could be used with an EFDA preamplifier. Considered together, a POSITA faced

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with Choy's PINFET detector 56 would not have been motivated to add additional amplification based on DeSalvo's teaching. Specifically, a POSITA would not have interpreted DeSalvo as suggesting to add an EDFA preamplifier to Choy in order to achieve a benefit (use of a PIN detector) where Choy discloses using a detector (a PINFET or avalanche) that includes amplification capabilities.

84. Dr. MacFarlane also states that adding the EDFA preamplifier to Choy's LRC "overcomes the demultiplexing losses" based on DeSalvo's teaching. Ex. 1202, ¶94 (citing DeSalvo, 5:5-9). But DeSalvo arranges the EDFA preamplifier before the tunable bandpass filter 34 selects a channel. Based on this teaching, a POSITA would not have interpreted DeSalvo's teaching to suggest arranging an EDFA preamplifier into Choy's LRCs, after demultiplexing has already occurred, in order to overcome demultiplexing losses.

85. Dr. MacFarlane also states that adding the EDFA preamplifier to Choy's LRC "can increase the signal level well above the receiver noise floor and increase the receiver sensitivity" based on DeSalvo's teaching. Ex. 1202, ¶94 (citing DeSalvo, 5:5-9). But as I have already noted, DeSalvo arranges the EDFA preamplifier before the tunable bandpass filter 34 selects a channel in order to increase the signal level. Based on this teaching, a POSITA would not have interpreted DeSalvo's teaching to suggest arranging an EDFA preamplifier into

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Choy's LRCs, after demultiplexing has already occurred, in order to boost the signal level.

86. Dr. MacFarlane also points to DeSalvo's teaching that "an optically amplified receiver" "allows increased transmission distances over the currently available technology." Ex. 1202, ¶¶89, 219 (citing DeSalvo, 2:3-5). But this statement does not provide a reason to incorporate an EDFA preamplifier into each LRC in Choy. Choy discloses that its disclosed WDM system is capable of transmitting up to 75km. "An input/output port of the grating is coupled to a fiber link that enables bidirectional, full duplex data communications with a second WDM at a distance of up to approximately 75 kilometers." Choy, 2:47-51; 4:35-39. If greater distances are desired, Choy teaches employing "an erbium-doped optical fiber 28 to increase the range of transmission and the maximum bit rate." Choy, 10:1-2. But even Dr. MacFarlane discusses that ranges were practically limited to 100km. He states, "one skilled in the art would have understood at that time that [optical] amplification could have occurred, and typically did occur, approximately every 100 km." Ex. 1202, ¶28. Dr. MacFarlane's belief that adding a preamplifier to a receiver would increase a system's transmission distance, without considering the other factors of the system's design, is an oversimplification that does not hold up. A POSITA seeking to increase the transmission distance of Choy's WDM system would first look to Choy's own

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teaching to incorporate optical amplification along the fiber 28, consistent with Choy's own teaching.

87. If additional optical amplification were desired at the receiving node of Choy, a POSITA might add an optical amplifier to amplify the optical signal, but consistent with DeSalvo's placement, this would have occurred before the grating and demultiplexing occurs. Further, a POSITA seeking to increase Choy's transmission distance would *not* wait until after signal has passed through the grating, been demultiplexed into separate channels and passed to the appropriate LRC, before optically amplifying each individual demultiplexed signal on the LRCs. This scheme would be expensive because multiple optical preamplifiers would be needed, it would be inefficient because it would ask the WDM to perform optical amplification  $n$  times (where  $n$  is the number of LRCs), rather than once before demultiplexing as taught by DeSalvo. Further, a POSITA concerned about adding optical amplification to increase transmission distance would add the optical amplification as soon as possible after receipt, and certainly before demultiplexing.

88. Dr. MacFarlane also states that DeSalvo's FIG. 1 teaches that "both an in-line EDFA repeater and the EDFA preamplifier in the optical receiver can exist simultaneously in an optical communications system." Ex. 1202, ¶94. This statement fails to acknowledge that Choy already discloses "an erbium-doped

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optical fiber 28 to increase the range of transmission and the maximum bit rate,” (Choy, 10:1-2), which would be interpreted by a POSITA as an EDFA repeater along the fiber 28. Choy also discloses an amplifier 58 in LRC 20 to amplify the output of Choy’s optical detector 56 (which may be a PINFET). Choy, 6:27-30.

89. Petitioners also allege that the optical preamplifier of DeSalvo “is beneficial for the large channel count and high data rate systems of modern communication systems.” Petition, 16 (quoting DeSalvo, 2:3-12 and citing to Ex. 1202, ¶89). But Dr. MacFarlane’s declaration does not support this statement, or otherwise allege that this benefit would have served as a reason to incorporate an optical preamplifier into Choy’s LRCs. In fact, Choy teaches that each LRC represents its own channel (see Choy, 3:1-3, 4:42-46), and that the “ability to select a particular IOC [input/output card] for different serial data stream protocols ... is an important feature of the invention.” Choy, 3:16-18. Further, Choy states that the “WDM 12 is capable of supporting a large variety of serial data stream types.” Choy, 4:50-51. Choy then proceeds to list a variety of exemplary protocols and data rates, extending as high as 1.25 Gb/s. Choy, 4:51-65. Neither the Petition nor Dr. MacFarlane even attempt to state that these rates would have been increased with the addition of an EDFA preamplifier to Choy’s LRC(s), and to increase the number of channels in Choy, a POSITA would have known to add another

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IOC/LRC set on each node of the WDM system consistent with Choy's teaching.

Choy, 3:1-5; 4:43-46; 7:29-42.

90. Dr. MacFarlane also proposes to incorporate DeSalvo's tunable bandpass filter 34 into Choy's LRC, as shown above in the annotated drawing. Ex. 1202, ¶¶96, 222. But this proposed incorporation of the bandpass filter 34 into Choy's LRC changes the operation of the bandpass filter 34, as Dr. MacFarlane admits. He states in his declaration: "the bandpass filter, while not being used to select a single channel from a multiplexed signal (since that is already done upstream by other components), would still be useful to remove the EDFA noise from the optical signal output by the EDFA preamplifier." Ex. 1202, ¶92. Further, Dr. MacFarlane fails to acknowledge that the optical signal received at connector 54 on the LRC has just previously passed through a demultiplexer of grating 24. In effect, the demultiplexer serves as a filter to pass only the desired wavelength for a given LRC, and there would have been no reason to add an additional filtering module to the LRC.

91. Dr. MacFarlane also contends that the location of the demultiplexer in DeSalvo, specifically the tunable bandpass filter 34, does not detract from the benefits of adding an EDFA arrangement to Choy's LRC. MacFarlane states, "a POSITA would have understood that this additional functionality of the bandpass filter—to filter out EDFA noise—would make such a bandpass filter useful as an

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optional component in an optical receiver that already receives a demultiplexed signal” and “would still be useful to remove the EDFA noise from the optical signal output by the EDFA preamplifier.” Ex. 1202, ¶92.

92. The sole reason that Petitioners and Dr. MacFarlane propose to incorporate DeSalvo’s tunable bandpass filter 34 to Choy’s LRC 20, after the EDFA preamplifier but before the PINFET detector 56, is to remove EDFA noise from the signal output by the EDFA preamplifier. But as I have explained above, a POSITA would not have had a reason to incorporate an EDFA preamplifier into Choy’s LRC 20, and therefore would not have had a need to remove EDFA noise between connector 54 and PINFET detector 56.

93. Dr. MacFarlane also relies upon Choy to allegedly disclose a “modulator for modulating an output of said optical transmitter” in claim 14. Ex. 1202, ¶208. This is inconsistent with the embodiment of FIG. 3A, which discloses that the “laser controller 48 operates the DFB laser 46 in accordance with the received ECL signal to generate a modulated optical signal for application, via connector 53 and single mode fiber 22, to the grating 24 for transmission via the fiber link 28.” Choy, 6:14-18. Here, Choy discloses that the DFB laser 46 generates a modulated optical signal, rather than generating a light signal that is then modulated. Dr. MacFarlane’s declaration earlier states that the “output of the DFB laser 46 is modulated by a modulator.” Ex. 1202, ¶202. As explained, this is

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not how Choy operates. Therefore, I disagree that Choy's FIG. 3A discloses an external modulator for modulating the light signal generated by DFB laser 46.

### **Takahashi**

94. Petitioners further seek to supplement DeSalvo's EDFA preamplifier disclosure to add two of Takahashi's "multiple EDFA structures, which include circuitry that measure input optical signal power, and compare the power to one or more reference values." Pet., 16-19. Dr. MacFarlane states that "Takahashi describes that the EDFA measures the energy level of an optical signal and uses comparators that compare the measured energy with reference voltage levels." Ex. 1202, ¶98 (citing to Takahashi). As I have explained above, a POSITA would not have had a reason to incorporate an EDFA preamplifier into Choy's LRC 20, and therefore would not have looked to Takahashi for EDFA implementations.

95. Also, Choy already discloses a mechanism for monitoring the incoming signal. As shown in FIG. 3A, Choy discloses that the PINFET detector 56 converts the optical signal into an electrical signal, which is then passed to an amplifier 58, and then split and passed to both an LRC safety circuit 60, and an ECL (Emitter Coupled Logic) comparator 62. Choy, 6:26-33. Of importance for this discussion is the safety circuit 60, because Choy is particularly concerned about the emission of a laser from a broken fiber. Choy, 8:37-39; 9:34-46. The laser safety circuit 60 includes a threshold detector 60a "operates to shut down the

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output of the DFB laser 46 whenever the detector 56 does not detect input light.”

Choy, 8:52-56; 9:36-38. In effect, Choy has used the PINFET detector 56 to convert the optical signal into an electrical signal, and then routed that electrical signal to both the safety circuit 60 having threshold detector 60a and to the ECL comparator 62 serving as an interface with the input/output card 14.

96. This architecture is different from the transceiver card claimed in at least claims 1-13 and 15 of the '898 patent, which include an “energy level detector optically connected between the receiver and the fiber input.” '898 patent, 7:1-2; also 8:10-16. While claim 14 does not explicitly recite these features, I note that claim 14 includes “a receiver configured to receive a second optical signal from the second optical fiber and to convert the second optical signal to output data,” and also includes “an energy level detector configured to measure an energy level of the second optical signal.” Further, the energy level detector of claim 14 must be on the transceiver card. Reading these claim phrases in concert, I interpret the usage of “second optical signal” to be consistent in these phrases. Therefore, the claimed energy level detector in claim 14 is also measuring “an energy level of the second optical signal.”

97. As disclosed in the exemplary embodiment of the '898 patent's Figure 2, the splitter/coupler 31 directs a portion of the received optical signal to the energy level detector 33, and directs the remainder of the received optical signal to

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the optical receiver 32. Further, as shown in the exemplary embodiment of Figure 3, the energy level detector 33 includes a photodetector 153.

98. In absence of an EDFA preamplifier on Choy's LRC, a POSITA would not have had a reason to look to Takahashi for EDFA implementations, and further would have recognized that Choy's safety circuit 60 already provides a detection function of the electrical signal outputted from the PINFET detector 56.

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I declare under penalty of perjury under the laws of the United States that the foregoing is true and correct.

Executed this 29<sup>th</sup> day of August, 2018 in Newark, Delaware.



Keith W. Goossen, Ph.D.